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The Pennsylvania State College Correspondence Courses in Nature Study

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Insect Life

LESSON NO. 2

THE HONEY-BEE

By GEORGE C. BUTZ

OF course, the bee is an insect. It may be regarded also as a domesticated animal. It is an excellent typical specimen of an insect, for it has two pairs of wings well adapted for flight, three pairs of legs developed for special service, and its body is in three well marked divisions—the head, the thorax (the chest), and the abdomen. All the legs and wings are attached to the thorax. (See Fig. 2.)

A remarkable thing about bees is the great amount of intelligence they display in their work, and we will regard them in this lesson not only as dumb animals but also as intelligent beings, because it has been the pleasure of many naturalists to observe the actions of bees and interpret them in the language of human thought.

Little do we realize, when we see a bee visiting a flower, that men have become gray and great in devoting their lives to the study of these marvelous little creatures. Many years ago strange stories were told about bees. You will find several interesting references to bees in the Bible, and it may be well to read them in this connection. The early naturalists and philosophers who wrote about bees have mixed much truth and error concerning their life history. Pliny who wrote nearly two thousand years ago, was not far wrong when he said that bees occupy the first rank among insects and that they were created for man, for whom their work

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procures honey and wax. He adds that they form political associations, that they have councils, chiefs, and even a code of morality and principles. Perhaps you will see the truth of these statements before we have finished with the bee. Many people have wondered where bees came from, and years ago, before any one had seen what happened in the interior of a hive, many fables were invented to account for their origin. Some pretended that bees sprang from an ox recently killed and buried in manure; others claimed that bees came from the interior of sweet-scented flowers. But about two hundred years ago an Italian made a glass hive so that he could watch the bees at their work, and then discovered many of the interesting facts which concern the origin and development of bees.

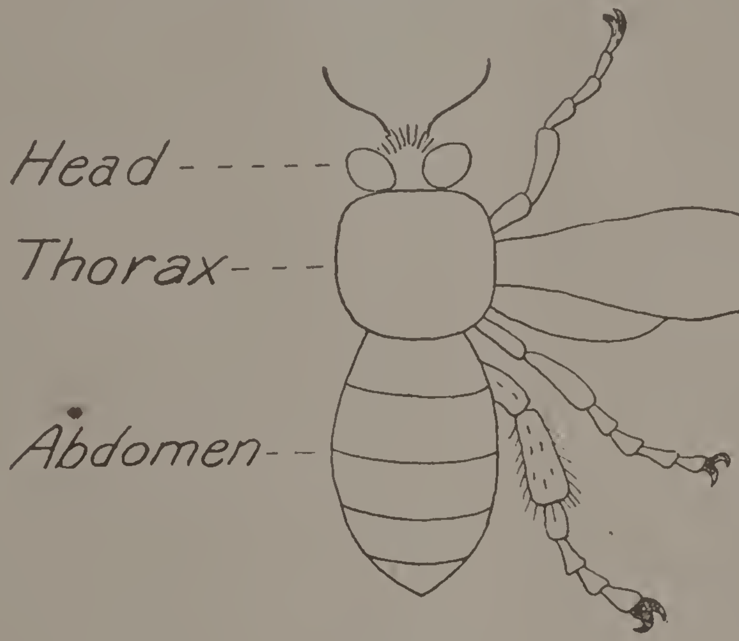

Fig. 2.

The honey-bees we have in this country are the descendants of importations from Europe made over two hundred years ago. There were no such bees here when the Indians occupied our land, and it has been said that bees moved westward more rapidly than man, so that the Indians soon observed that bees were the index of the approach of the white man. Bees are now found over all the world inhabited by man. Where they are not furnished with hives, they make their homes in hollow trees of the forests.

Honey-bees live in large familes or societies, sometimes called colonies. They are known as social bees. Other kinds of bees are solitary in their habits; while a third class are known as guest bees, because they form no nests of their own, but are entertained in the nests of other bees. There may be as many as 20,000 in one society of honey-bees, and, living as they do, all in one house, there must be some sort of regulation to maintain peace and harmony; for bees, like men, have jealousies, passions, strifes and ambitions which need control. So there should be a president, a governor or a king for this great population; and we find in each hive a bee larger than the rest, a female which alone has the power to lay eggs. She never goes out of the hive to gather honey, does no work in the hive, but, on the other hand, is caressed, brushed, fed, and in many ways waited upon by the other bees. Because of this distinction she is called the *Mother-bee*, or, more commonly, the Queen bee. We shall see that she deserves the title of Queen.

The male bees are few in number, and are despised by the general population because they will not work. They are all gentlemen of leisure, or lords to the Queen. Because they will not work they are called "drones." We seldom see them, because there are none about until May, and soon after the new swarms are all settled in their chosen quarters, the drones are all killed or driven from home. You have sometimes heard a bee fly past you with a sonorous, buzzing sound; this is a drone. In size it is much larger than the worker bees, even larger than the Queen. It is quite hairy and is not provided with a sting.

The great majority of the bee population is of "workers. They gather honey, pollen and propolis and secrete wax; they build the combs, nurse the young, guard the entrance to the hive, wait upon the Queen, fight the battles with intruders, and remove the dead that would pollute their castle. We recognize among them the architects, the masons, the harvesters, the nurses, sentinels, servants to the Queen, etc. These workers are also termed *neuters*, being females without the ability to deposit eggs. They are all provided at the posterior end of the body with concealed weapons, the sting, with which they guard their interests. The drones do not have a sting, but the Queen has a very powerful sting, which she never uses except against a rival Queen.

The working tools of the bee are its mouth and legs. The mouth is a long proboscis, very different from that of the fly which we have seen. It has a pair of stiff, pin-like mouth parts, called mandibles, projecting from the head, and between them is a slender tongue projecting much beyond the mandibles, covered at the end with delicate hairs. With this, liquid honey in flowers is licked, lapped or sucked up and thus taken into the first stomach, or honey stomach. When this stomach is filled, the bee hastily returns to the hive and expels from its mouth the gathered honey. The mandibles, being stiff and sharp, are used to cut open flower tubes or buds to reach the honey or to gather solids, like the propolis, needed for the walls of the hive.

The legs are adapted also to the work of the bee. The two hind legs are furnished with very broad joints with margins of stiff hairs and a few small hairs over the surface, forming a basket in which is carried the pollen. When a bee enters a flower for honey, it covers itself with yellow pollen. When it emerges it brushes off the pollen with its hind legs and gathers it in the baskets. You may have seen bees on their way to the hive with yellow masses on their legs.

Having now characterized the three different kinds of bees in a colony, let us observe them at work in the hive. We will consider that the hive is new and the Queen, with her followers, has just taken possession of it.

Materials of construction are needed. Promptly a goodly number of bees fly off to gather *propolis*, a gummy excretion found on the buds of many plants and trees, especially the poplar. This is carried home in the mandibles and turned over to other workers, who use it to close up all cracks and holes, except the one for exit and entrance. The whole interior wall is covered with this propolis. By the way, this propolis is also used for embalming dead bodies within the hive. If an animal, for example, a slug, should enter a hive unobserved, it is stung to death as soon as it is discovered; and, as it is too large to be dragged out, it is at once completely covered with propolis, which preserves the body, and the hive is not polluted. Or, if the animal is a snail, a similar animal having a shell, only the opening is covered and the snail enclosed.

The next operation is to build the comb, of which the material is wax — beeswax. It was once thought that wax was made by the bee from pollen, taken into the stomach of the bee and expelled from the mouth. It is now known that when wax is needed, a certain number of the workers gorge themselves with honey and hang from the roof of the hive in curtain-like masses. The feet of bees are provided each with a pair of strong hooks, by means of which they can hang together in long chains or festoons. The first one hooks his front feet into the roof, the next one joins his front feet to the hind feet of the first, and so on until a large number have joined them. After about twenty-four hours of quiet suspension the wax begins to exude from the lower surface of the abdomen of each bee, and other bees — the builders or masons — come and remove the wax and begin to lay the foundations for combs. The bees must consume about twenty-one pounds of honey to produce one pound of wax; therefore they regard it as very expensive material, and, in their use of it, they design to economize as much as possible.

And now we approach another remarkable evidence of the intelligence of bees — the plan of the comb, or cluster of cells. The cells are all hexagonal; that is, six-sided, and the cells are so arranged that double service is gained from each wall. (See Fig. 3.) Of course, square cells would fit together as closely, but the deep angles are objectionable. The preference is for a cell with a circular outline; but we cannot cluster circles without considerable loss of space and double walls. (See Fig. 4.) So you see the wisdom of these little economists in choosing the six-sided cell. The comb is suspended from the roof; that is, the course of construction is from above downward, just the reverse from our way of building a house. Each comb has two courses of cells, arranged back to back, or base to base. These little masons are rapid workers, for it has been observed that in a colony of average size these cells have been constructed at the rate of 4,000 in twenty-four hours.

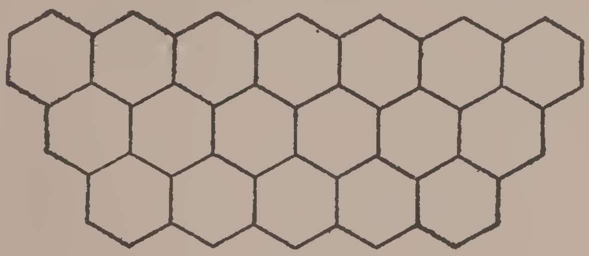

Fig. 3.

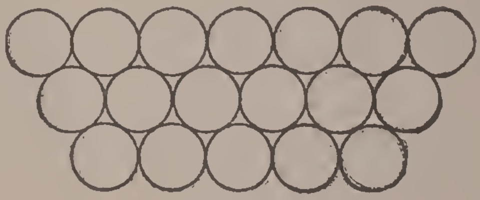

Fig. 4.

The cells are of three sizes,—one for the worker bees, the smallest; another for the drones, the next size; and lastly, for the Queens. (See Fig. 5.) You understand, of course, that these cells are not only for storing pollen and honey, but also, and primarily, for cradles in which to nurse the babies. Nevertheless, many cells are made exclusively for honey.

There are always many more cells for worker bees than for drones, and a comparatively small number of cells for Queens—say from ten to twenty. These last are called royal cells, for they are very large and of peculiar construction.

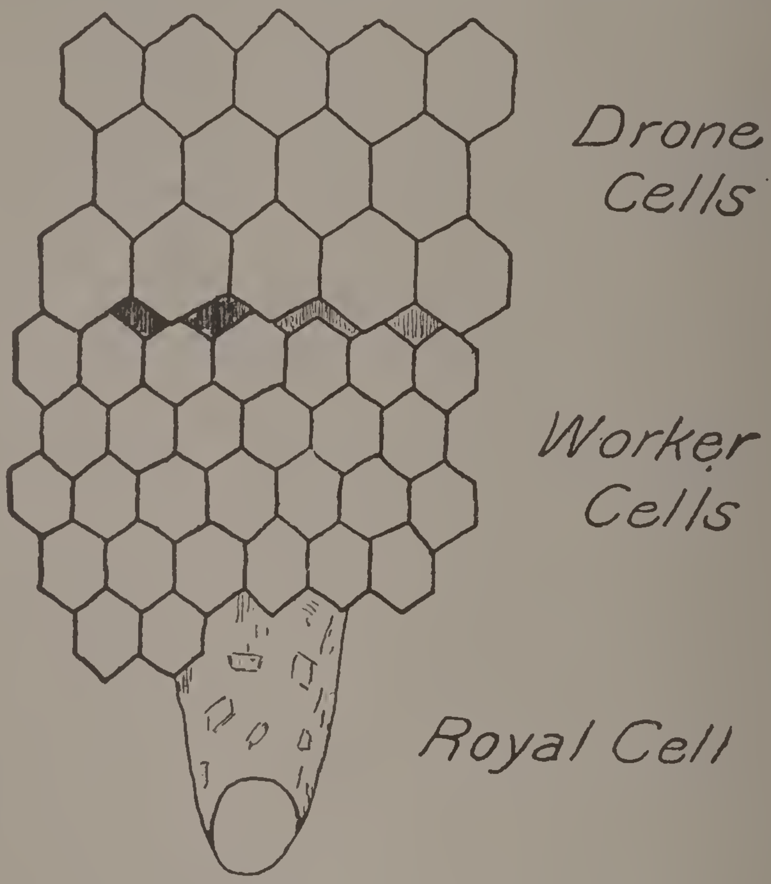

Fig. 5.

The Queen of the colony, who, as we have said, lays all the eggs, deposits one in the bottom of each cell and glues it fast. In this work the Queen is attended by several worker bees, and if by chance more than one egg is dropped in a cell, the attendants hasten to carry out and destroy all the eggs in excess. The laying of eggs is continued as fast as cells are made ready, from spring until fall, and as many as 200 eggs are laid in a day. That would make 6,000 in a month.

After the eggs are laid, they are left to the care of the workers—the nurses. It is said that young worker bees are wax workers and the old bees are collectors of honey and nurses. In about six days after an egg is laid it hatches, and a small white, legless grub, or larva (corresponding to the larva of the house-fly, which we called the maggot) is born in the cell. The nurses visit it frequently and feed it, for it is helpless and cannot go in search of food. While very young, the grub is given a kind of pap prepared from the pollen, or bee-bread, as it is called. The pap is prepared in the stomach of the bee, and resembles paste made from flour. As the young larva gets older, its food is made to resemble honey, and in five days its growth as a larva is completed and it has no more use for food, as it is about to pupate — that is, turn into a chrysalis. Therefore, the nurse pays a last attention by closing up the cell with a cover of wax. Thus confined within its cell, the larva spins about it a fine silky cocoon and awaits its resurrection day. About eight days later a wonderful transformation has been completed and the young bee is ready to come forth, with fully developed wings, legs and mandibles, and for the first time see daylight. It cuts through the wax covering of its cell and is greeted by the nurse bees. They lick it, brush it, and offer it honey. After twenty-four hours the new bee joins the working force of the colony. The time for the development of a worker bee from the laying of the egg to the mature bee is about twenty days; for a drone, it takes twenty-four days.

The process for the development of a Queen is slightly different. The egg is laid in a royal cell, and, as the larva grows, the dimensions of the cell are increased, and instead of common pap for food, the young princess receives a special and peculiar food. It is called *royal jelly*. It is heavier and sweeter than the pap of the common bees, but is produced similarly in the stomach of the bees. It has a remarkable power in producing Queens, for if the Queen of a hive dies, the workers select a larva of a worker bee under three days old, enlarge its cell to the size of a royal cell and begin feeding it royal jelly, and it becomes a Queen instead of a simple worker. Thus we see that the food and cradle make the Queen. It takes but thirteen days for the development of the Queen from the time the egg is laid.

Of course, each day several hundred new bees are being added to the hive, which soon becomes crowded. When a new Queen is hatched out the old one gets very jealous and attempts to kill her rival. But the worker bees endeavor to save the life of the young Queen, and if they succeed the old Queen calls for her friends, announces her intention of leaving the old castle, and takes to flight. There is great excitement at such times. The bees are all in great haste, running to and fro about the hive as if crazy. The old Queen drops her eggs anywhere about the hive; she tries to kill the young bees trying to escape from their cells, but is firmly resisted by the workers. Soon the Queen makes for the door of the hive, and the bees after her. They fly with her in a cloud to a nearby tree and collect there in a "swarm." They become quiet again and may be captured without much difficulty, or a few of the bees go off to select a place for a new nest, and the Queen accepts their choice. When she is in the new quarters the systematic work begins again.

If bees are not killed or frozen to death, they are said to live two or three years, devoted to constant labor. A hive often produces from twelve to twenty pounds of honey each year. It has been accurately determined that bees usually gather their honey within a radius of two miles, though often they have been found four or five miles away from home. The rate of speed they make has been variously determined. One observer recorded that the wings of a bee made 190 vibrations in a second, and that this number of wing strokes would carry the bee at the rate of one mile per minute. But another observer estimated, from the note of the sound made by the bee in flight, that over 400 vibrations of the wing would be necessary to produce it, and that this rate would carry the bee two miles per minute. It is evidently very difficult to make a correct calculation on these points.

Now, we have considered a great many interesting facts about bees, but many more could be told. Perhaps you will have an opportunity of studying more about bees by watching them at their work in the flower or in the hive.

SUGGESTIONS TO THE TEACHER

It should not be difficult to get a few worker bees in rural districts where bees are kept, and a comb with honey is as easily obtained.

The drawings accompanying this paper should be enlarged upon the blackboard before presenting the lesson.

Every pupil should be made to observe closely the structure of the bee, as presented in Fig. 2.

Point out the four stages of the bee: first, the egg; second, the larva; third, the pupa in the chrysalis, and fourth, the imago, or full-grown bee.

Point out that the average family of bees consists of one mother bee (Queen), 2,000 drones, or males, and 20,000 workers; that the males are allowed to live only about two months in early summer, but that the workers and Queen may live two or three years if they survive the winters.

Observe that there is remarkable division of labor.

Call attention to the helpless condition of the larvæ in the cells; that the nurses do not fly out for food, but take from the store that has been gathered.

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